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MODERNIZING A TRUNK LINE.

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MODERNIZING A TRUNK LINE

A STORY OF THE

Permanent Improvements on the Lackawanna Railroad Since 1899

REPRINTED BY PERMISSION OF THE RAILROAD GAZETTE
FROM ITS ISSUE OF NOVEMBER 14, 1902.

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NEW PASSENGER STATION AT DOVER, N. J.

1-24-54

MODERNIZING A TRUNK LINE.

WHEN the change in management of the Delaware, Lackawanna & Western took place, in the spring of 1899, the incoming officers found a road which extended from the seaboard to the Great Lakes, through New Jersey, the mountainous regions of Pennsylvania and the undulating area of southern and western New York, with branches into the slate and cement regions of Pennsylvania and New Jersey, the Lackawanna and Wyoming anthracite fields, and the agricultural, dairy and industrial area of Central New York. The ruling grades and curves were severe, but so located (as in the approaches to Scranton, the Mt. Pocono and Mt. Morris summits, etc.), that it was not feasible to change them radically and the policy of former managements had been to handle traffic in short trains with small cars and correspondingly small locomotives.

The track was in fair condition, but the line was equipped, in many places, with bridges too light for heavy motive power, and in such shape that it was usually necessary to replace substructure as well as superstructure. The water supply was badly located and inadequate; roundhouses, passing sidings and terminal yards were too small to serve a road worked with modern equipment; in short, there was need of general renovation.

Starting at once with heavier motive power on those portions of the line where the bridges could stand it, the use of large locomotives was extended as fast as the bridges and other structures could be made ready for them, until the average train length had been greatly increased, and running time was very much reduced. President Truesdale, in his first annual report, in 1899, said that the problem which the company had to consider and solve was that of "decreasing its transportation cost by the use of heavier locomotives and cars, and the adoption of modern methods and improved devices for maintaining its property," and it has been necessary to make practically all the progress

achieved along these lines, without the usual possibilities of bettering grade and curvature. The policy of the management furthermore required that these changes be made as earnings afforded, so that unusual effort has been required in the engineering, mechanical and operating departments, but it is safe to say that in the great wave of activity in betterment work which has passed over the railroads of the country during the last two or three years, few roads have been more progressive than the Lackawanna. The changes also include the installation of block signals, interlocking plants, new passenger stations, and a large variety of other betterments which will be taken up more in detail later on.

BRIDGES AND MASONRY.

The large amount of work to be done in rebuilding bridges and masonry, and the maintenance and safety of traffic during this reconstruction, made it both economical and desirable to do as much work as possible by company forces, rather than by contract, and warranted the expenditure the company has made in providing an efficient plant for this purpose. In order to handle the bridge and building and the masonry work to the best advantage, the system was divided in March, 1901, into three divisions, with a Superintendent of Bridges and Buildings on each division. The first of these is the Morris & Essex, which operates in the suburban and industrial territory of New Jersey and has grades generally not over 45 ft. per mile. The second division, known as the Scranton Division, is in the mountainous and coal regions of Pennsylvania, with grades from 50 to 78 ft. per mile for lengths of 18 miles. The third, or Buffalo Division, is in the long plain of southern New York, with working grades of 20 ft. per mile, with a maximum of 60 ft. for one stretch of eight miles.

The company employed its own inspectors to do all of the inspection of steel bridge work at the shops, as well as a part of the mill inspection; and four bridge erecting crews were equipped and are now doing all the erection of steel bridge work. Each of the three

NEW BRIDGE OVER PASSAIC RIVER, WEST OF PATERSON, LOOKING EAST.

NEW BRIDGE OVER SUSQUEHANNA RIVER, NEAR BINGHAMTON, N. Y.
SIX 160-FOOT RIVETED TRUSS SPANS.

divisions is provided with a 50-ton capacity steam wrecking derrick, of the type illustrated, and in addition each Superintendent of Bridges and Buildings has a 20-ton steam derrick car for light and quick work. All of these machines, together with other equipment, are used in the erection of bridge work, removing old masonry, etc.

During the past three years the company has contracted for 35,923 tons of steel work for bridges and 1,367 tons of steel work for buildings, making a total of 37,290 tons. Twenty-four thousand three hundred and sixty-five tons of the steel bridge work have been erected, of which 13,895 tons have been erected by contract, and 10,470 tons have been erected by the railroad company. During this time 449 bridges of various kinds have been ordered, and 316 of them have been completed. Of this total number, 244 are steel railroad bridges, and 205 are highway bridges and concrete arches and concrete box culverts under railroad embankments. One hundred and sixty of the steel railroad bridges (including eight new draw bridges), and 156 of the other class (including one new highway draw bridge) have been completed. The total length of steel railroad bridges which have been ordered is equivalent to 3.82 miles of double track, of which 2.66 miles have been completed. In this connection it may be stated that no derailments or injuries of any kind to the traveling public have been caused on account of the rebuilding work on bridges and masonry. The cost of this bridge work erected, including masonry substructures, pile foundations, new timber floors and the removal of old bridges, will exceed $3,700,000.

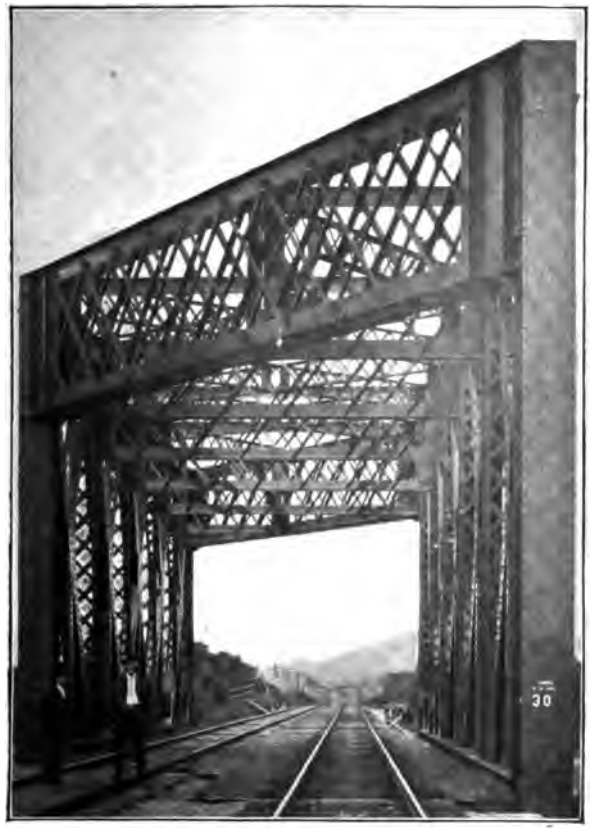
Several large and notable pieces of bridge work have been completed, among which may be included the new double track through riveted truss bridge over the Susquehanna River near Binghamton, N. Y., which consists of six 160 ft. spans on new masonry. Two thousand six hundred and twelve tons of steel work was used on this bridge, of which a photograph is shown.

East of Elmira, N. Y., a new double-track bridge over the Erie Railroad and Par-

DECK RIVETED TRUSS SPANS OVER ERIE R. R. AND PARSCHALL'S COVE, EAST OF ELMIRA, N. Y.

schall's Cove has been completed, and contains 1,786 tons of steel work. This structure consists of one through and three riveted truss spans with ballasted floor, and has a total length of 625 ft., and is on a skew of 30 deg. The end posts of the through and deck spans are plumb, the portal for the through span being 64 ft. long.

Over the Passaic River west of Paterson, N. J., a new double-track bridge and viaduct has been completed, which is 643 ft. long and 80 ft. high above the river, and contains 1,149 tons of new steel work. The old structure consisted of one 83 ft. lattice truss span, one 200 ft. deck pin span over the river, and six 60 ft. trestle spans of riveted lattice type supported by plumb tower posts. The new bridge consists of three 30 ft. spans, two 66 ft. spans and two 70 ft. trestle work spans, two 100 ft. spans over the river with arched legs, and one 81 ft. span. All of the new spans are deck plate girders. It was designed so that nearly all of the masonry and all of the steel towers for the trestle work were completed without in any way interfering with traffic. The old 200 ft. river span was replaced with two 100 ft. plate girder spans with steel arched legs supporting the ends of girders, the arched legs being supported by new center pier in the river. The 100 ft. girders were proportioned on the assumption that their end supports were 100 ft. center to center. The top of the new river pier is 34 ft. 8 in. below base of rail, and was carried to such height as would clear the bottom chord of the old 200 ft. deck span. When the old bridge was removed the distance from base of rail to the top of new pier was made up by the depth of the new 100 ft. plate girder and arched leg forming its support. In the dismantling of the old bridge and the erection of the new structure no false work whatever was used, with the exception of false work for taking the dead load only of the 200 ft. river span when it was taken down. In other words, the old bridge was utilized for traffic as well as false work for the erection of the new bridge, and the new bridge used as false work from which the old structure was taken down, and at no time was traffic carried on any false work. The old bridge throughout consisted of three lines of deck trusses, spaced 11



END VIEW OF THROUGH RIVETED TRUSS SPAN OVER ERIE R. R. AND PARSCHALL'S COVE, EAST OF ELMIRA, N. Y.

ft. centers, carrying double-track, and the new bridge consisted of four lines of girders carrying double-track, and spaced so as to clear the trusses of the old bridge. The erection was done by the company, and traffic was handled on single track while the steel deck above the new towers was being erected.

At the Passaic River crossing near Lyndhurst, N. J., an entire new double-track deck plate girder bridge has been built, which consists of one 61 ft. 6 in. span, two 105 ft. 6 in. spans, and one 158 ft. 10 in. plate girder draw span. The new draw bridge consists of two plate girders, and has two lines of stringers with floor beams, and is a center bearing bridge. The girders are spaced 19 ft. 6 in. center to center, and each girder with one line of stringers carries a track. The old draw bridge was a three-truss through riveted bridge, with trusses spaced 15 ft. centers. The work of renewing the entire crossing, including the taking down of the old draw bridge and the old fixed spans, as well as the erection of the new fixed spans and new draw bridge, was accomplished without any false work whatever. Both the old and new structures were utilized as false work and for carrying traffic during this reconstruction. The only time during the year in which it is permitted to block navigation at this crossing is from Feb. 1 to Feb. 20.

At the Upper Hackensack crossing, near Seacaucus, N. J., a new double-track, through riveted truss bridge has been built on a new location. The old bridge consisted of a 176 ft. 2 in. riveted truss draw span, with pile trestle approaches. The new structure consists of four 124 ft. 6 in. fixed spans and one 236 ft. draw span. The depth of water at this crossing is 52 ft., and from base of rail to rock foundation it is 117 ft. The bed of the river is covered with about 20 ft. of silt deposit, and between the rock and silt deposit there is a bed of good clay. In the construction of the foundations the open caisson process was adopted. Piles 90 ft. long were driven for the center pier, and 85 ft. piles were used for the rest piers of the draw span. The piles for the pivot pier and two rest piers of draw span were cut off 31½ ft. below low tide. Riprap was placed around the outside

NEW 158-FOOT 10-INCH DOUBLE TRACK PLATE GIRDER DRAW SPAN OVER PASSAIC RIVER, AT LYNDHURST, N. J.

of the piling, and the space between the piles was filled with gravel. The riprap and gravel were carried up to within two feet of the cut-off of piles before the pile stays were removed, and before the piling was cut off. The maximum lateral movement occurred in the pivot pier of the draw span after the weight of new bridge was placed upon it, and amounted to 3 in. in the direction of the stream. Some of the other deep water piers moved about 2 in. in a similar direction when the weight of the bridge was placed upon them. The vertical settlement averaged ¼ in. per each course of timber in the bottom of the caissons, and was the amount allowed for in the construction. Since the traffic has been turned over the structure, which was in July, 1901, no further lateral movement or vertical settlement of the piers has occurred of consequence, and recent soundings show practically no change in the riprapping that was placed around the piling. These foundations were put in at a cost of $100,000. and the total weight of metal in the new bridge is 1,755 tons. Its total length is 755 ft. The draw span was erected on the new protection pier. The four 124 ft. 6 in. fixed spans were duplicates. False work was put in for the erection of one fixed span at each extreme end of the structure. The other two fixed spans were erected on the false work for end span at the west shore of the river, and were lifted from this false work on scows and floated across the river and landed in place.

At the lower crossing of the Hackensack River, near Bergen Tunnel, west of Hoboken, N. J., two 201 ft. 3 in. double-track through pin truss spans and one 194 ft. 10 in. double-track through riveted truss draw span have been erected. Owing to the short time, as previously mentioned, when traffic can be blocked in the Hackensack and Passaic Rivers, it will be seen that it would be a physical impossibility to erect a draw span on the site of the old bridge by the ordinary methods of false work. The lower Hackensack bridge is located on the suburban line of the road, and 178 trains cross this bridge a day.

The maintenance of traffic during the erection of the new draw bridge, together with its erection, were the most important engineering feature connected with the renewal of

the crossing. On account of the depth of water, which is 50 ft. in the draw channels; height of bridge above the water, and character of the material in the bed of river, with consequent difficultly of getting false work of sufficient stability, it was decided not to erect the new draw bridge on false work forming an extension of the old protection pier and roll it into place on trucks at the same time the old bridge was rolled out. Instead of this plan the new draw bridge was erected on false work along the shore of the river, and when the time came for making the move, the old draw was lifted from its bearings onto four scows by removing water ballast from them with centrifugal pumps, and the old bridge was floated out of the way along the shore. The new bridge was lifted from its false work on four scows in a similar manner, and landed on the pivot pier. The weight of the draw bridge is 603 tons. The total weight of the bridge, including the false work trusses between the decks of the scows and the under side of the bridge, was 743 tons. The time required to move the old bridge out and replace it with the new draw span, and move both of the 201 ft. 3 in. fixed spans endwise 18 in. ready for traffic was 10½ hours. The old draw bridge was landed on the false work on which the new draw had been erected and was there taken apart.

The suburban line of the road also crosses the Passaic River at Newark, N. J., at which crossing a new double-deck riveted 221 ft. draw bridge was completed in April, 1901. The old draw bridge at this point was not of sufficient strength for traffic, and the new bridge was designed as a double-deck structure so that it could be used in connection with the Newark track elevation, which was to come later. The conditions for the erection of this bridge were similar to those at the lower Hackensack crossing, and the same method was adopted for moving the old bridge out and the new bridge in. The chief difficulty to be encountered in an operation of this kind, where there is tide water, is due to the erratic variations in the heights of the tides, and the fact that the tides place a time limit on the different moves to be made. Daily readings of high and low tides were taken for a period

BRIDGE OVER PASSAIC RIVER, WEST OF PATERSON. ARCHED LEGS ON CENTER PIER SUPPORTING ENDS OF 100-FOOT PLATE GIRDER SPANS.

OLD PASSAIC RIVER DRAW BRIDGE, AT NEWARK, ON SCOWS ALONG SHORE, AFTER BEING REMOVED TO MAKE PLACE FOR NEW DOUBLE DECK DRAW BRIDGE.

of three months prior to the move, and it was found that frequently the high tide did not rise above 0 or mean tide, and quite often the high tide rose 4 ft. above mean or 0 tide. A number of these readings also showed that there were several days in which low tide did not fall below mean tide, and other readings showed a low tide 3 ft. 0 in. below mean time. From this it will be seen that the maximum and minimum variations between high and low tide were 7 ft. 0 in. and 0 feet respectively, and that this erratic variation was the chief factor that might jeopardize the success of the undertaking. The average variation between high and low tide readings under normal conditions were 5 ft. 0 in. To insure the success of the operation, the false work trusses on the scows had to be built of such height that the scows could be placed under both the old and new bridges at low tide, which might be at a height of mean tide or might be three feet below mean tide. At the same time the new bridge must be lifted high enough so that when floated in over the center pier it would clear the pier at the lowest high tide that might occur, which was 0 or mean tide. The work was planned on the assumption that the worst conditions would be encountered, and, as a matter of fact, on the day that the bridges were moved low tide fell only 4 in. below 0 or mean tide, and high tide reached a point 3 ft. 10 in. above mean tide. This extreme high tide delayed the releasing of the scows from underneath the new draw bridge after it was landed on the pivot pier, and required a longer time to complete the operation than it would have required had the high tide been normal. Had not the plans been prepared on the assumption that the worst conditions indicated by the readings would occur, the bridges could not have been moved on the date set. The old bridge was lifted from its bearings on four scows, and moved out of the way along shore. It was later landed on the false work on which the new bridge had been erected and was there dismantled. The new draw bridge was erected on false work along the shore and floated into place on four scows, each scow being 29 ft. wide, 90 ft. long and 9½ ft. deep over all. The lifting of these bridges from their supports was accomplished by pumping water ballast from the

NEW DOUBLE DECK RIVETED TRUSS DRAW BRIDGE OVER PASSAIC RIVER, SHOWING CONCRETE CENTER PIER ON WHICH NEW DRAW BRIDGE WILL BE PLACED.

scows with centrifugal pumps. In moving the new draw bridge the total weight carried above the decks of the four scows was 1,220 tons, and the top chord of the bridge when afloat was 66 ft. above the water line. The weight of the new draw bridge itself, including timber deck and rails, was 845 tons. A volume of water equivalent in weight to 845 tons was let into the scows before the new bridge was lifted, which left the scows with a freeboard of 23 in. when the pumps were started. It took 45 minutes continuous pumping with four centrifugal pumps having 8 in. suctions and 6 in. discharge pipes to lift the new bridge from its false work. The pumps were run at a safe and conservative speed, and each pump removed 1,250 gallons of water per minute without any stoppages for the entire 45 minutes, at the end of which time all of the water was out of the scows. In other words, the four pumps increased the buoyancy or lifting power of the boats at the rate of 37,500 lbs. each minute for the entire time. By the time sufficient water had been removed from the boats so as to transfer the load from the false work to the boats, the tide had risen 9 in., leaving a freeboard of 14 in. The time required to move the old bridge out and the new bridge in, raise the two 108 ft. deck truss approach spans 18 in. and get the new bridge in shape for traffic was 12 hours, which was within the limits of the time schedule set for doing the work and the resumption of traffic over the bridge.

The new line of the Newark track elevation crosses the river 35 ft. farther north and parallel to the present center line of tracks. The double-deck draw bridge when utilized in connection with the elevation will have to be moved 35 ft. northward and lowered down 10 ft. 6 in. The weight of the draw bridge with additional parts, including both of its timber and metal decks complete, will be 985 tons, and the moving of this bridge to the new line and lowering it down 10 ft. 6 in. will be an important engineering feature connected with the Newark track elevation, as it must be completed inside of 12 hours to follow the action of the tides, and it will also be necessary to avoid interference with traffic as much as possible.

Near Dansville, N. Y., two large fills have just been completed, resulting in the abandonment of 893 lineal feet of double-track iron trestle bridge. One of these old structures is 124 ft. high, and the other is 157 ft. high.

Paradise Tunnel, which is located near the summit, east of Scranton, is to be made an open rock cut, and work on this is now three-fourths completed.

The company's lines reach the Portland cement regions of New York, Pennsylvania and New Jersey, and all of the masonry (except 3,172 cu. yds.) has been built of Portland cement concrete. During the year 1900 there were 25,875 cu. yds. of masonry laid, of which 12,416 cu. yds. were done by contract, and 13,459 cu. yds. by the Bridge and Building Department of the company. In 1901 there were 49,923 cu. yds. of masonry laid, of which 9,874 cu. yds. were done by contract, and 40,049 cu. yds. by Bridge and Building Department. For the year 1902 no contracts have been let for masonry construction, with the exception of that for the Newark track elevation. About 44,000 cu. yds. of masonry will be completed during the season of 1902 by company forces, making an approximate total of 120,000 cu. yds. for the three years, not including the Newark track elevation. Of this total about 90,000 cu. yds. is for bridge structures, and the balance for engine house foundations, retaining walls, cinder pits, etc. The fact that all of the erection of steel bridge work in 1899 and first half of 1900 was done by contract, while all erection of steel work is now being done by the bridge and building forces, together with the above statements regarding masonry construction for the three years, illustrate clearly the development of the policy to do work with company forces rather than by contract.

TRACK ELEVATION THROUGH NEWARK AND HARRISON.

The dividing line between Harrison, N. J., and Newark, N. J., is the center line of the Passaic River, Newark being located west of the river. The main suburban line of the

NEW DOUBLE TRACK THROUGH RIVETED TRUSS DRAW BRIDGE, AFLOAT IN MID-STREAM HACKENSACK RIVER CROSSING.

road passes through Newark and Harrison. At present there are 13 street crossings in Harrison, nine of which are at grade and four are subways under tracks. In the city of Newark the railroad tracks cross 27 streets, all of which are grade crossings, with one exception. There are 172 passenger trains and six freight trains passing over the line each day. When the contemplated improvements have been completed all the grade crossings in Harrison will have been eliminated, and only one grade crossing will remain in Newark. From the easterly limits of Harrison to High street in Newark, a distance of one and one-half miles, the tracks of the railroad will cross above the streets. From High street west to the city limits, on the main line and Montclair Branch, the railroad tracks will be depressed between retaining walls with street crossings overhead. The elevation and depression will be for three tracks.

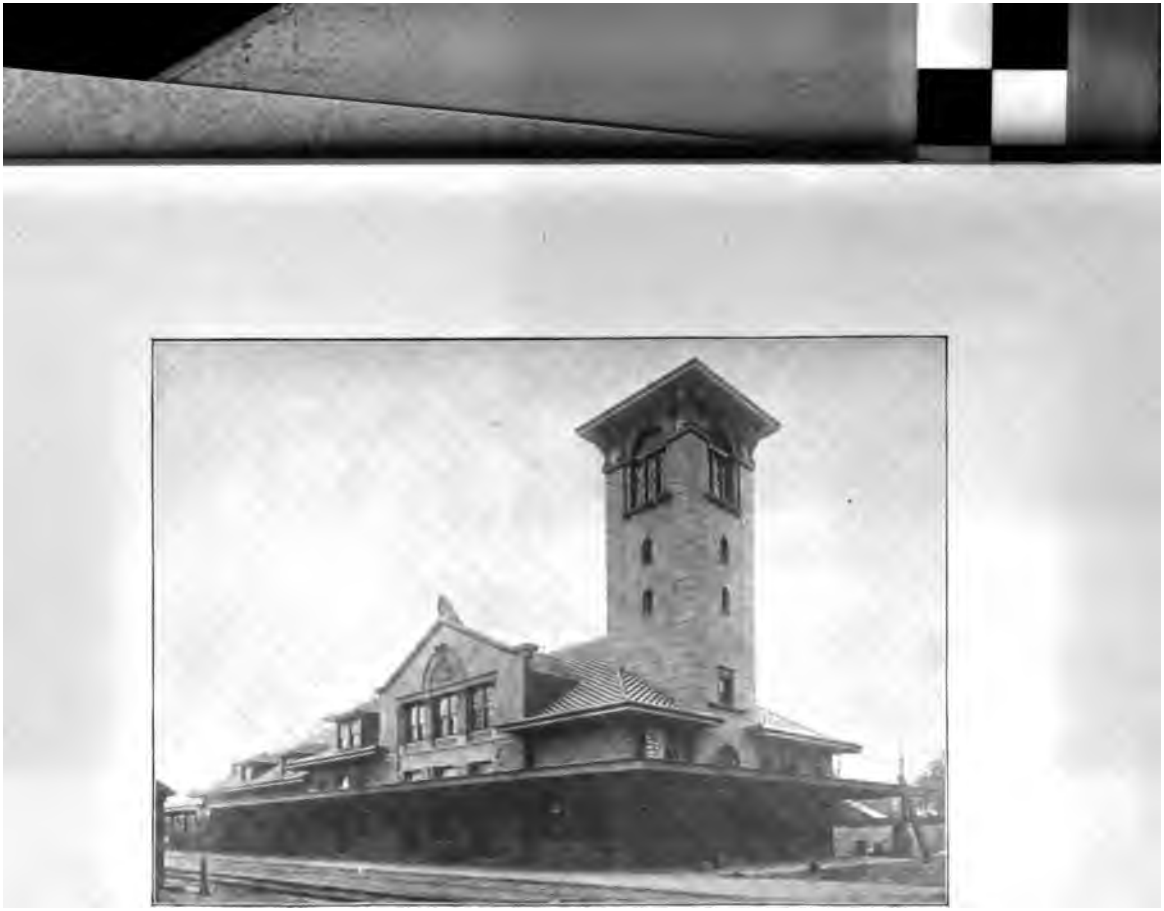
In connection with the work of elevating and depressing of tracks, a new passenger station, new freight house, express building and freight yard are to be built in Newark, and a new station built at Harrison.

The present maximum grade of the railroad through Newark is 138 ft. to the mile, and when the track elevation is completed the grade will be reduced to 60 ft. to the mile, and the alignment very much improved.

At the Passaic River crossing the bridge structure will be double deck. The river crossing proper will consist of one 221 ft. double-deck draw bridge, and two double-deck approach spans, with steel trestle work on either end of the approach spans. The top deck of these structures will be double-track and for passenger service, and the lower deck will be single track for a freight line into the new freight yard at Newark.

In the Newark and Harrison track elevation work there will be about 109,000 cu. yds. of masonry, and 6,250 tons of steel work for bridges. The work on this improvement was begun early in 1902, and the contemplated improvement will be completed in about three years, and will cost about $3,000,000.

88½-FOOT PLATE GIRDER FOR HIGHWAY BRIDGE AT LESTERSHIRE, N. Y., BEING PLACED WITH A 50-FOOT GIN POLE BY LACKAWANNA RAILROAD ERECTING CREW. WEIGHT OF GIRDER 35 TONS.



NEW PASSENGER STATION, BINGHAMTON, N. Y.

BUILDINGS AND STRUCTURES.

Statistics of the new structures of various kinds which have been built in the last three years show eight new engine houses, with a total of 139 stalls, and three more engine houses now building Ten brick and 10 frame station buildings have been built at a cost of $215,000, and two more brick stations are under contract. The new structures have improved greatly the appearance of the line, besides providing for the convenience of patrons, and a number of characteristic examples are shown in the photographs, of which the new Dover station and the one recently completed at Binghamton are especially noteworthy. Five new brick freight houses, fourteen 60-ft. turn-tables, nineteen 100-ton track scales, eight concrete ash pits, seven new engine coaling stations and five new retail coal trestles have also been built, at a total cost for freight houses, turn-tables, etc., of $279,400.

The yards at Hoboken have been entirely remodeled by the removal of the old office and freight building from a central location in the old yard, to a location on the street lines, and 70 miles of tracks have been laid in the rearrangement of the terminal, including changing the main tracks of the passenger yards to take out curvature, and relaying with new 80-lb. rail; change of the coach yard where additional tracks were put in, etc.; laying all main tracks in freight and coal yards with 75-lb. rail, equipping with the latest type of slip switches, point switches and standard plate riveted frogs made at the company's shops. The new buildings at Hoboken include a long two-story brick structure for railroad offices and the express company, a new freight house, a three-story fire-proof building for the storage of the company's records, a new carpenter shop with modern equipment, for the bridge and building department, the rebuilding of four large piers, on one of which a freight house 78x1,280 ft. is building, extensive repairs to four other piers, and a new locomotive coaling station, etc. Dock work contemplated for the near future also includes a new

shipping pier at a cost of $175,000. The total amount alrea
ildings is $1,912,000, and about $500,000 additional is to be sp
Scranton,
in the water supply which, as stated, was inadequate for the
scope of business, resulted in building 49 new water tanks, 52
ses, six deep wells, five steel stand pipes and four reservoirs.
)9 $500,000 has been spent in modern equipment of automati
devices, etc. At Hoboken a 38-lever electro-pneumatic int
ontrolling all passenger train movements at the terminal, 2
n a single-track basis, have been equipped with new automat
ire system 335 train order signals, 25 interlocking plants,
tic semaphore posts, with 775 signals, have been installed.
ystem were changed from white for clear and green for ca
ellow for caution.
ct. 1, 1899, the Road Department was under the charge o
in all, who reported to the division superintendents. In S
IcFarlin was appointed Chief Engineer of the system and all
work is under his supervision. Mr. L. Bush is Principal Assis
d has been with the company since December, 1899. Mr. A. J
ster, and has served in that capacity since October, 1899. An
y disclosed the fact that some divisions held thousands of t
e badly needed on other divisions. A general transfer of this
e renovation of yards, building of additional track facilities a

NEW BRIDGE OVER PASSAIC RIVER, WEST OF PATERSON, LOOKING WEST.